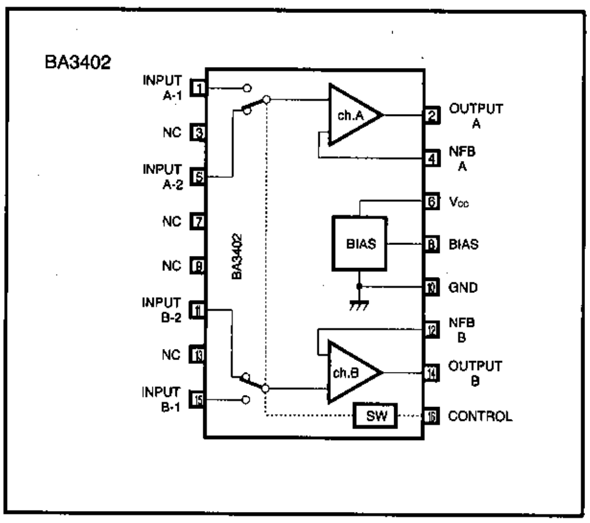
Dual-channel, auto-reverse tape preamplifier
BA3402

The BA3402 is a dual preamplifier developed for auto-reverse car tape decks. An electronic switch on the chip switches between the forward and reverse heads, and this has the benefits of greater reliability, easier wiring, lower space requirements, and improved assembly efficiency when compared with conventional mechanical switches. The circuit is designed in such a way that coupling capacitors are not required. In addition to reducing the number of external components required, this ensures that the head is not magnetized when the power is applied.

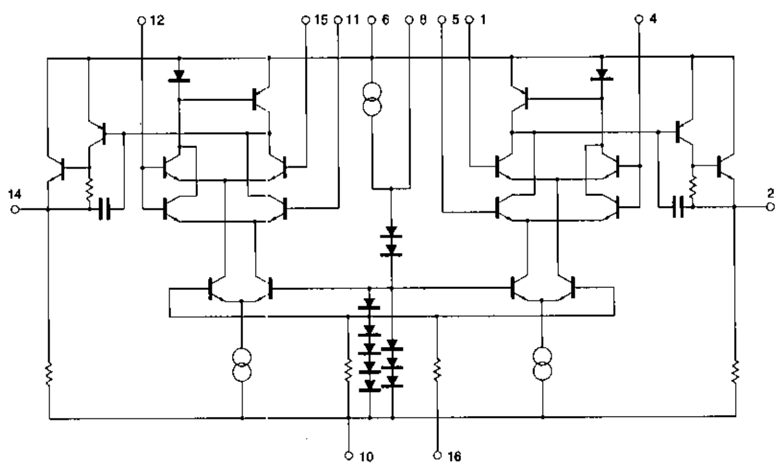
●Applications
Car stereos and play-only auto-reverse cassette decks.

●Features
1) Low noise (V_{NIN} = 1.2 μVrms).
2) High open-circuit gain (G_{VO} = 85dB).
3) Reliable electronic switch on the chip. Head switching for both left and right channels is possible with the addition of one external switch circuit.
4) Input-side virtual-ground design means that input coupling capacitors are not required.
5) Built-in bias circuit reduces external component requirements.
6) Low "pop" noise during head switching.
7) Emitter-follower output circuit with large drive capacity.
8) Pin layout allows easy PCB design.
9) Compact package allows high PCB wiring density.

●Block diagram



●Internal circuit diagram



●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	V_{CC}	14	V
Power dissipation	Pd	400*1	mW
Operating temperature	Topr	−25~75	℃
Storage temperature	Tstg	−55~125	℃

*1 Reduced by 4.0mW for each increase in Ta of 1°C over 25°C.

●Electrical characteristics (unless otherwise specified Ta = 25℃ and Vcc = 8V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent current	I_Q	−	4	5.5	mA	CONTROL pin : OPEN	Fig.1
Open-loop voltage gain	G_{VO}	70	85	−	dB	V_{OUT}=0.3V_{rms}, f=1kHz	Fig.1
Input conversion noise voltage	V_{NIN}	−	1.2	2.0	μV_{rms}	R_g=2.2kΩ, B.P.F 30Hz~20kHz	Fig.1
Maximum output voltage	V_{OM}	1.5	2.0	−	V_{rms}	THD=1%, f=1kHz	Fig.1
A−B Channel cross talk	CT_{AB}	37	50	−	dB	R_g=2.2kΩ, f=1kHz	Fig.1
1−2 Channel cross talk	CT_{1-2}	57	65	−	dB	R_g=2.2kΩ, f=1kHz	Fig.1
Input bias current	I_B	−	150	500	nA	V_{IN}=0V_{rms}	Fig.1
Total harmonic distortion	THD	−	0.1	0.3	%	V_{OUT}=0.3V_{rms}	Fig.1
Control pin threshold L	V_{THL}	1.2	−	−	V		Fig.1
Control pin threshold H	V_{THH}	−	−	2.8	V		Fig.1

●Measurement circuit

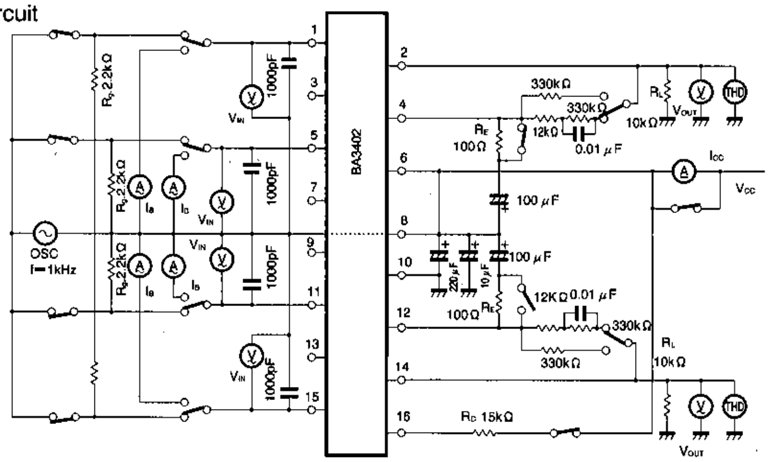
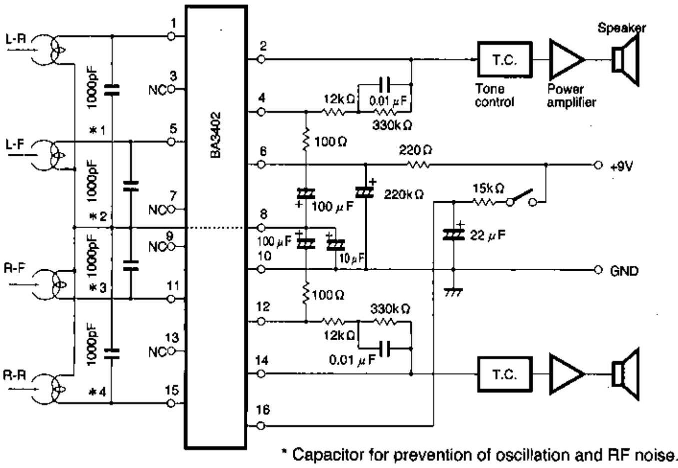


Fig. 1

●Application example



* Capacitor for prevention of oscillation and RF noise.

Fig. 2

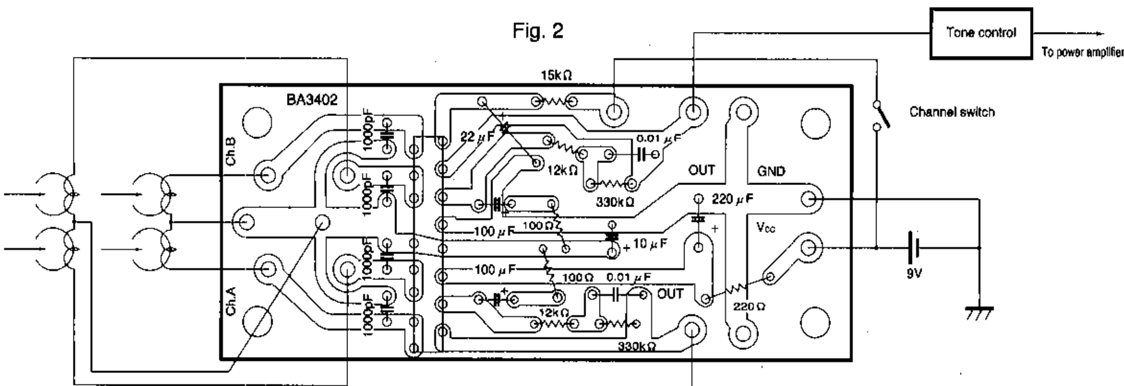


Fig. 3 Print pattern example

●Electrical characteristics curves

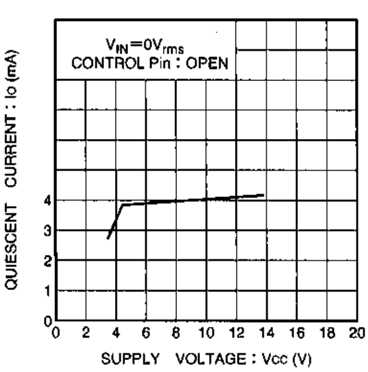


Fig. 4 Quiescent current vs. supply voltage

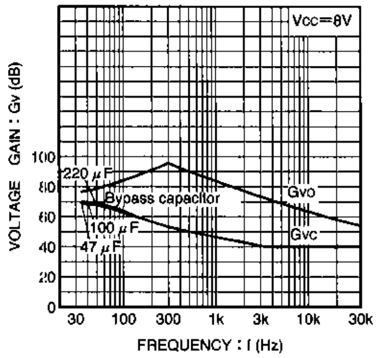


Fig. 5 Voltage gain vs. frequency

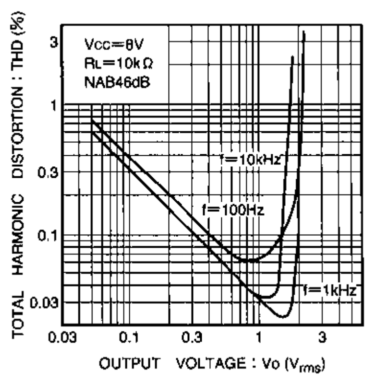


Fig. 6 Total harmonic distortion vs. output voltage

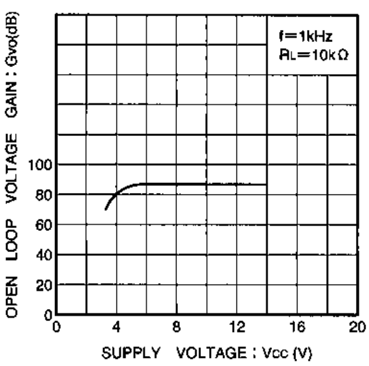


Fig. 7 Open-loop voltage gain vs. supply voltage

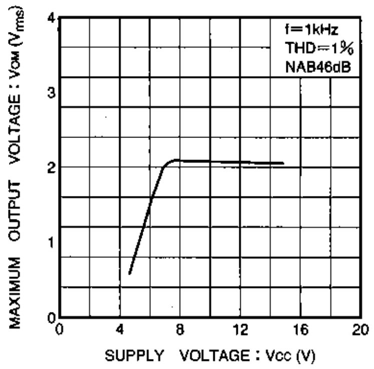


Fig. 8 Maximum output voltage vs. supply voltage

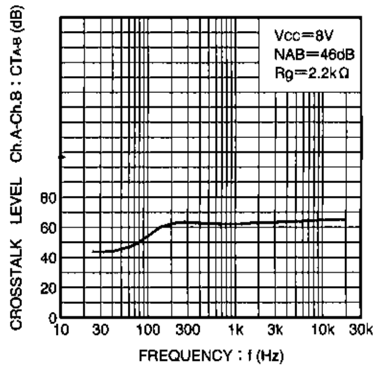


Fig.9 Crosstalk vs. frequency

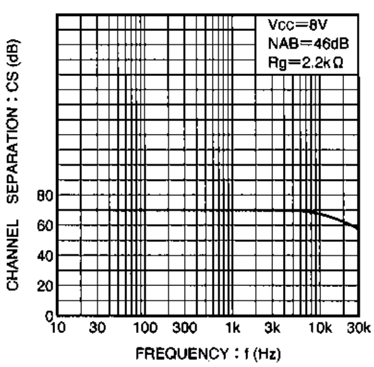


Fig. 10 Channel separation vs. Frequency

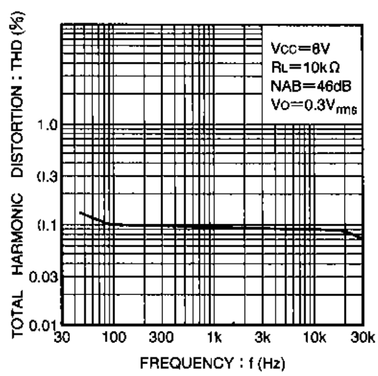


Fig. 11 Total harmonic distortion percentage vs. frequency

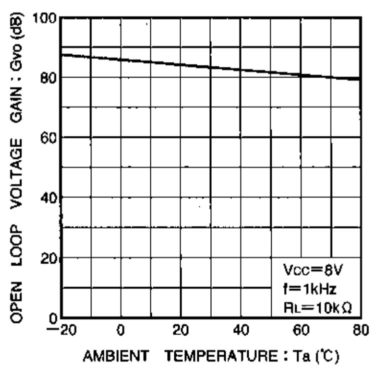


Fig. 12 Open loop voltage gain vs. ambient temperature

●Electrical characteristics curves

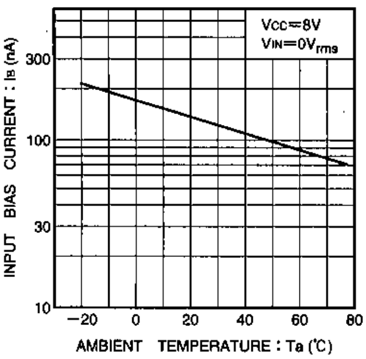


Fig. 13 Input bias current vs. ambient temperature

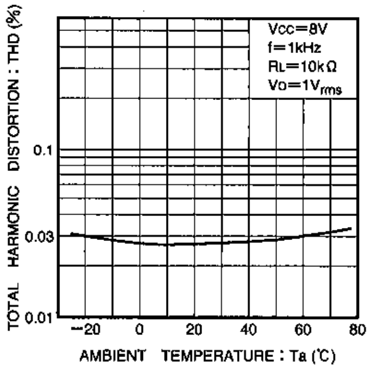


Fig. 14 Total harmonic distortion percentage vs. ambient temperature

●Operation notes

(1) Input-side virtual ground

If coupling capacitors are used to connect the head with the preamplifier input, the capacitor charging current flows in the head and can magnetize it. To prevent this, a virtual ground is used on the input side, and coupling capacitors are not required, even with a single-rail supply.

This is the bias pin input and the virtual ground point for the negative feedback, and the bias for the input transistor is taken from this terminal. The only DC current that flows in the magnetic head is the base bias current for the input transistor, which is not enough to magnetize the head.

If a floating input is not possible due to the construction of the magnetic head, or wiring considerations, connect the input via a coupling capacitor and bias the transistor using a resistor as shown in Fig.15.

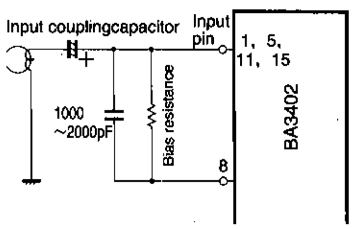
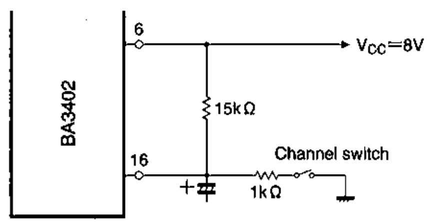


Fig. 15

(2) Channel switching control

When the control pin is connected to Vcc via a resistor, channels A-1 and B-1 operate, and when it is open circuit, channels A-2 and B-2 operate. The recommended value for the resistor is 15kΩ.

This resistor, the capacitance of the capacitor connected between the control pin and GND, and the 20kΩ pulldown resistor on the IC determine the switching speed. Switching speed increases as the value of the capacitor is reduced. Set the switching speed so that it matches the timing of the reversing mechanism. Note, that if the switching speed is too fast, a "pop" noise will be generated. The circuit in Fig. 16 illustrates how to perform channel switching by connecting the control pin to GND. Note, that the switching speed from channel 1 to channel 2 and from channel 2 to channel 1 is different.



Note: Values when Vcc = 8V

Fig. 16

(3) Output coupling capacitors

In car stereos, the preamplifier output passes through the tone control circuits before going to the power amplifier, so it is possible to eliminate the output coupling capacitors. Coupling capacitors are required when the preamplifier output is used directly as the deck output with no tone control, or when it is connected directly to power amplifier.

(4) Capacitor for prevention of oscillation and RF mixing
With the BA3402, a capacitor must be connected between each input pin and the bias pins to prevent oscillation and RF mixing. The recommended value for this capacitor is 1000pF to 2000pF. If it is too small, oscillation and RF noise can adversely influence circuit performance. Conversely, if the value of the capacitor is too large, it will adversely influence the audio frequency characteristics. These capacitors can also be used for treble compensation. Determine the value based on the relationship with the magnetic head impedance.

(5) Bypass capacitor
The capacitor connected in series with the gain-setting resistor between the NF pin and the bias pin is the bypass capacitor. The value of this capacitor determines the bass characteristics. The variation in bass characteristics for different values of this capacitor is shown in Fig. 5.

(6) Playback equalizer
The playback equalizer curve is determined by the RC circuit connected between the output pin and the NF pin. For the circuit shown in Fig. 17, with a closed-loop gain of GVC (dB) at a frequency of 1kHz, the value of the circuit components is given by the following equations :

$$R_2 = 15.6 \times R_3 \times 10^{G_{VC}/20} \quad (\Omega)$$

$$R_1 = \frac{2}{53} \times R_2 \quad (\Omega)$$

$$C = \frac{3180 \times 10^{-6}}{R_2} \quad (F)$$

The recommended value for R_3 is about 100Ω. If R_3 is too large, the voltage gain will not match the calculated value.

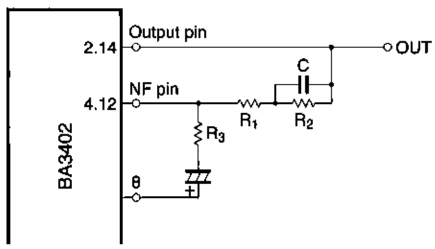
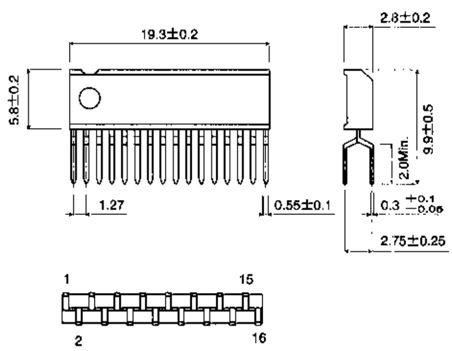


Fig. 17

●External dimensions (Unit: mm)



ZIP16